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## NEW AND REDESCRIBED SPECIES OF LEDERMUELLERIA FROM NORTH AMERICA (ACARINA: STIGMAEIDAE)<sup>1</sup>

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OUDEMANS (1923)<sup>4</sup> created the genus *Ledermuelleria* (originally *Ledermülleria*) for seven species which he transferred from *Caligonus*, *Raphignathus*, and *Stigmaeus*. Additional species have been referred to the genus since then. The genus thus comprises a substantial array of species, which are very uniform in their generic features. Problems in identification arise because the species have been described one or two at a time by various authors. The consequence is that generic rather than specific characters are emphasized in their descriptions and illustrations. Hence it has seemed desirable to emend the prior descriptions of *segnis*, *clavata*, *rhodomela*, *ottavii*, *lacuna*, *pectinata*, and *plumifer*, and to prepare a key for the identification of females for the eleven species, including four new ones, considered in this paper.

The following named species not described herein complete the roster of species for the genus. The list includes also several species originally described in other genera which are believed to be appropriate to *Ledermuelleria*.

*Raphignathus brevis* Banks, 1910, Wash. Ent. Soc. Proc. **12**(1):3.

*Ledermülleria oudemansi* Thor, 1930, Skrifter om Svalbard og Ishavet Nr. 27, p. 99, figs. 50–1.

*Ledermülleria favosa* Sellnick, 1932, Zool. Anz. **99**(5–6):167–71.

*Caligonus collarti* Cooreman, 1955, Soc. Roy. d'Ent. de Belg. Mém. **27**:162–70.

*Ledermülleria longisetosa* Willmann, 1956, Československá Parasitol. **3**:237–8.

*Ledermülleria neomaculata* Meyer and Ryke, 1959, Nat. Hist. Ann. and Mag. **2**(ser. 13):216.

*Ledermülleria lineolata* Meyer and Ryke, 1959, Nat. Hist. Ann. and Mag. **2**(ser. 13):217.

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<sup>4</sup> See "Literature Cited" for citations referred to in the text by author and date.

The prior descriptions of *segnis*, *clavata*, *rhodomela*, *ottavii*, *lacuna*, *pectinata*, and *plumifer* are herein amended, and four new species are described. A key for the identification of females is given for the eleven species considered in this paper.

The species of *Ledermuelleria* included in this study comprise three general groups. The smallest of these is the "segnis" group, containing forms with curved, plumiform dorsal setae and one pair of genital setae, and it includes only *segnis* and *modiola* n. sp. A second group is the "maculata" group, containing robust forms with club- or rodlike dorsal setae, 2-3 pairs of genital setae, and usually a very thick exoskeleton in which the so-called dimples appear as coarse perforations. The species in this group are *ottavii*, *clavata*, *rhodomela*, *lacuna*, and *schusteri* n. sp. The occurrence of peculiar callosities in the vicinity of the humeral platelets greatly assists in separating several of these quite similar forms. A third group, "pectinata," is comprised of several slightly smaller species which possess bushy dorsal setae, 3 pairs of genital setae, and plates crinkled with closely set dimples; these are *craticula* n. sp., *lirella* n. sp., *plumifer*, and *pectinata*.

### Key to Species of *Ledermuelleria* Recently Identified from North America—Females

1. (a) Dorsal setae bushy or burrlike ..... 2
- (b) Dorsal setae otherwise ..... 5
2. (a) Four setae on femur II ..... *pectinata* (Ewing)
- (b) Five setae on femur II ..... 3
3. (a) Without recognizable eyes; vertical setae *ae* recurved,  
    situated on apical lobe of propodosoma ..... *lirella* n. sp.
- (b) Eyes present; vertical setae relatively straight, with axes erect,  
    situated on propodosoma near base of apical lobe ..... 4
4. (a) One pair of anomalous dimples within area bounded by dorso-  
    central hysterosomal setae pairs *a* and *b*; a cribriform plate  
    occupies depressed area within these two dimples  
    (fig. 16) ..... *craticula* n. sp.
- (b) Hysterosomal plate without these anomalous  
    dimples ..... *plumifer* (Halbert)
5. (a) Dorsal setae acicular or claviform; 2 or 3 pairs genital setae ... 6
- (b) Dorsal setae flattened and bilaterally spinulate; 1 pair genital  
    setae ..... 10
6. (a) Tarsus IV with a minute solenidion ..... 7
- (b) Tarsus IV without solenidion ..... 9
7. (a) Two pairs setae on genital plate; major callosity in pleural  
    membrane, no minor callosity ..... *schusteri* n. sp.
- (b) Three pairs setae on genital plate; major and minor callosities  
    in pleural integument above humeral plate ..... 8
8. (a) Humeral setae *he* very short, approximately one fourth as long  
    as preoculars *be*; dorsal plates thinly sclerotized, with dim-  
    pling faint ..... *ottavii* (Berlese)
- (b) Humeral setae short, approximately one half as long as pre-  
    oculars; dorsal plates with dimpling readily apparent, dim-



- ples equally spaced but graduated in size, largest near margins, smallest middorsally ..... *rhodomela* (Koch)
9. (a) Middle pair of setae on anogenital covers much shorter than other 2 pairs; propodosomal plate with marginal incision between setae *ce* and *de*; major and minor callosities very small, situated on margins of dorsal plates (fig. 36) *lacuna* (Summers)
- (b) Three pairs of setae on anogenital covers subequal; propodosomal plates without marginal incisions; no callosities in humeral region of pleura ..... *clavata* (C. & F.)
10. (a) Postocular setae approximately one half as long as preoculars; length of each seta of intercalary pair *li* less than distance between them ..... *modiola* n. sp.
- (b) Postocular setae two thirds as long as preoculars; length of each intercalary seta exceeds distance between them... *segnis* (Koch)

### **Ledermuelleria segnis (Koch)**

(Figs. 9, 13-15)

*Caligonus segnis* Koch, 1836.

*Ledermuelleria segnis* (Koch), Oudemans, 1923.

*Female.* Dorsal plates with uniform pattern of indented dimples, these circular to oval in outline; lining of each dimple finely vacuolated, which imparts a granular texture to its periphery in optical section (fig. 9). Dorsal setae characteristically recurved, falciform; their shafts have sharp marginal spinules disposed at almost equal intervals; spinules graduated in length as shafts taper to sharply pointed tips (fig. 13). Tubercles of vertical setae *ae* located in an inferior position on propodosoma, overlying chelicerae. Postocular setae *ce* approximately two thirds as long as preoculars *be*. Setae of dorsomedian rows on hysterosoma longer than distance between their successive alveoli; intercalary setae *li* close together, their lengths greater than distance separating individuals of this pair. Two endocoxal plates of propodosoma completely united in mid-line to form a "prosternum"; corresponding plates of metapodosoma incompletely united in mid-line; sternal plates plain or with faint sculpturing as described for dorsum; when faint, pattern appears as a polygonal lattice or reticulum. Genital plate widened close behind metapodosoma to cover broad area of opisthosoma, flanked by ventral rami of suranal plate from which it is not distinctly separated; only 1 pair genital setae widely spaced. Three pairs setae on anogenital covers, confined to posterior half of covers; setae of each pair overlap bases of setae next in line. Counts of setae, including spiniform sensilla, on podomeres of legs I-IV: femora 6-5-3-2, genua 4-3-1-1, tibiae 7-6-6-6, tarsi 14-9-8-7. Measurements in microns ( $\bar{M} \pm \sigma$ ,  $n = 10$ ): length idiosoma (bases of vertical setae to end suranal plate)  $297 \pm 8$ ; width at sulcus  $247 \pm 9$ ; leg I (coxotroch. artic. to claw tips)  $173 \pm 4$ ; lengths of setae (measured as straight line, or chord, between base and tip): preoculars *be*  $76 \pm 4$ , intercalaries *li*  $76 \pm 4$ , dorsomedians *c*  $77 \pm 3$ .

*Male.* Description of female applicable to male except for normal sex differences (fig. 15). Idiosoma smaller, more fusiform; opisthosoma conical,

with anogenital valves in terminal position. Each tarsus I-IV bears one robust sex-associated solenidion  $w\sigma$ . Retracted aedeagus ensheathed by a complex of sclerites.

*New Distribution Records.* One ♀, San Andreas Lake, San Mateo County, California, Oct. 28, 1956 (D. W. Price), *ex* soil under live oak; 5 ♀♀, Sawyer Ridge, San Mateo Co., Calif., Nov. 4, 1956 (D. W. Price), *ex* grassland soil; 1 ♀, 1 ♂, Sawyer Ridge, San Mateo Co., Calif., Nov. 18, 1956 (D. W. Price), *ex* soil under chaparral; 1 ♀, Pilarcitos Lake (1 mi. S), San Mateo Co., Calif., Nov. 12, 1956 (D. W. Price), *ex* soil under Douglas fir; 16 ♀♀, Colfax, Calif., Apr. 11, 1957 (S. F. Bailey), *ex* leaf mold under manzanita; 1 ♀, Coal Bank Pass, Colorado, Aug. 1958 (D. W. Price), *ex* pine mulch; 3 ♀♀, Winters, Calif., Apr. 23, 1959 (F. C. Raney), *ex* soil sample; 2 ♀♀, Bridgeport, Calif., May 11, 1959 (L. M. Smith), *ex* soil; 1 ♀, Contra Costa Co. (1 mi. S jet. Marsh Crk. and Morgan Terr. Rds.), May 26, 1959 (L. M. Smith, R. O. Schuster), *ex* mulch under oak; 10 ♀♀, 4 ♂♂, Winters, Calif. (5.4 mi. SW), May 29, 1959 (F. C. Raney, L. M. Smith, R. O. Schuster), *ex* soil under mixed vegetation; 1 ♀, Dunsmuir, Calif. (20 mi. S), July 18, 1959 (F. C. Raney), *ex* soil under poison oak; 1 ♀, Dunsmuir, Calif., July 18, 1959 (F. C. Raney), *ex* soil under *Acer douglasii*.

### *Ledermuelleria modiola* n. sp.

(Figs. 7, 10-12)

*Female.* A relatively small, slender-bodied species (fig. 12). Dorsal plates thinly sclerotized, coarsely dimpled; dimples irregularly rounded polygons, circumferences smooth; many tend to be elongate in anteroposterior direction; no evident vacuolation within walls of dimples (fig. 7). Dorsal setae plumiliform, flattened, recurved in degree illustrated (fig. 11), widest in middle two thirds, margins flared, uniformly serrate to tips; serrations or spinules numerous, short, almost uniformly spaced. Preocular setae *be* approximately twice as long as postoculars *ce*. Dorsomedian setae on hysterosoma not longer than distance between their successive alveoli. Intercalary setae *li* widely spaced; distance between their alveoli exceeds length of setae. Two endocoxal plates of ventral propodosoma incompletely coalesced in mid-line; posterior margin of this sclerite invaded by longitudinal striae. Endocoxal plates of metapodosoma well separated in mid-line; longitudinal striae displaced between these plates to accommodate an elliptical depression in mid-line. Genital plate divided into right and left halves by forward extension of striae bordering hinged margins of anogenital covers; lateral margins of genital plate not separated from ventral rami of suranal plate, with but 1 pair genital setae. Three pairs setae on anogenital covers; anteriormost pair situated on anterior third of covers. Setae and sensilla of appendages numerically equal and qualitatively similar to those of *segnis*. Measurements in microns ( $n = 2$ ): length idiosoma 220; width at sulcus 131; leg I 111; lengths of setae (measured as straight line between base and tip): preoculars *be* 43, intercalaries *li* 35, dorsomedians *c* 41.

*Male.* As illustrated (fig. 10).

*Types.* Holotype ♀, Sawyer Ridge, San Mateo County, California, Nov. 4, 1956 (D. W. Price), *ex* grassland soil. Holotype deposited in United States



National Museum. One paratype ♀, 3 paratype ♂♂, same series, retained by authors.

### **Ledermuelleria craticula n. sp.**

(Figs. 6, 16–17)

*Female.* A small species most nearly resembling *plumifer*. Propodosoma tapered to pointed apex, with conical protuberance below, between vertical setae (fig. 16). Dimples in dorsal plates large, deep, closely set, irregular in shape and size, mostly polygonal; each dimple circumscribed with 10–15 shallow, crescentic indentations to produce appearance of sinuous periphery (fig. 6). Several anomalous dimples peculiar for species: 1 pair on propodosoma situated on line between postocular setae *ce* with craters compressed to slitlike depressions; 1 pair modified dimples on hysterosoma on opposite sides of mid-line between dorsomedian setae *a*, *b*; their craters shallow, occupied by thickened cribriform integument (fig. 16). Eyes present near preocular setae, dioptric apparatus partly obscured by sculptured skeleton. Dorsal setae subequal, all very short, bushlike (fig. 17); spinules tufted on distal halves. Sternal, genital plates as in *pectinata* but without apparent reticulation. Chaetotaxy of appendages similar to *plumifer*. Trifid sensillum on palptarsus sessile. Measurements in microns ( $n = 4$ ): length idiosoma 230; width at sulcus 152; leg I 124; dorsal setae: preoculars *be* 18, intercalaries *li* 26, dorsomedians *c* 17.

*Male.* Not found.

*Types.* Holotype ♀, Cajon Pass (5.4 mi. S), San Bernardino County, California, Mar. 31, 1959 (F. C. Raney), *ex* litter under silk tassel, *Garrya* sp. Deposited in United States National Museum. Two paratype ♀♀, same series; 1 paratype ♀, Jacolitos Canyon, Fresno Co., Calif., May 16, 1959 (H. L. Wilson) *ex* soil; retained by authors.

### **Ledermuelleria lirella n. sp.**

(Figs. 4, 18–19)

*Female.* Another close relative of *plumifer*, with sharply embossed plating, burrlike setae. Propodosoma hyperbolic in outline, tubercles of vertical setae on apical lobe (fig. 18). Dimples in dorsal plates deeply invaginated, closely appressed, outlines polygonal; separating folds relatively thin, without obvious vacuolation in optical section (fig. 4). No eyes. Groups of coarse pits not discernible on dorsum. Dorsal setae subequal, flattened, somewhat recurved; shaft of each smooth on basal fourth, spinose on distal three fourths; spinules coarse, sharp, overlapping, tightly clustered (fig. 19). Ventral plates as in *pectinata*; genital and sternal plates, coxae and femora dimpled. Counts of setae on podomeres same as *clavata* and *plumifer*, but many common setae on ventral aspect of legs clearly spinose or barbed. Trifid sensillum on palptarsus not sessile, its shaft at least as long as terminal prongs. Measurements in microns ( $n = 7$ ): length idiosoma 274; width at sulcus 196; leg I 137; setae: preoculars *be* 41, intercalaries *li* 41, dorsomedians *c* 37.

*Male.* Not known.

*Types.* Holotype ♀, Springville (2 mi. W), Tulare County, California, May 13, 1959 (L. M. Smith), *ex* soil and screenings from nest of woodrat;

deposited in United States National Museum. Six ♀♀ paratypes, same series, retained by authors.

The recognitional characters are burrlike setae, no eyes.

### **Ledermuelleria plumifer (Halbert) new comb.**

(Figs. 5, 20–21)

*Raphignathus plumifer* Halbert, 1923.

*Female.* Propodosoma hyperbolic in outline, slightly pointed anteriorly, with a small, irregularly shaped lobe or protuberance in front, below vertical setae (fig. 21). Dimples in dorsal plating deeply impressed, situated so closely together that separating walls are thin, their craters angular in outline; invaginated skeleton with small uniform, subsurface vacuolation, about 15 vacuoles festooned around periphery of each dimple; skeletal fold separating adjacent dimples thus shows (phase contrast) 2 almost contiguous rows of vacuoles (fig. 5). Endocoxal, genital plates as in *pectinata*. Dorsal setae short, recurved, very bushy; whorls of outwardly directed spinules on distal four fifths of cylindrical shaft (fig. 20); greatest spread of spinules exceeds one half total length of entire seta for at least 8 pairs dorsals. Chaetotaxy of leg podomeres as given for *pectinata* except 5 setae instead of 4 on femora II. Trifid sensillum of palptarsus sessile. Measurements in microns ( $n = 6$ ): length idiosoma 278; width at sulcus 214; leg I 137; setae: preoculars *be* 30, intercalaries *li* 39, dorsomedians *c* 32.

*Male.* Described by Halbert (1923).

*New Distribution Records.* One ♀, San Mateo County (3 mi. N Sharp Park), California, Dec. 16, 1957 (D. W. Price), *ex* chapparal (soil); 1 ♀, Mount Diablo, Calif., May 26, 1959 (L. M. Smith, R. O. Schuster), *ex* sandy soil under oak, laurel, moss; 4 ♀♀, Contra Costa Co. (1 mi. S jet. Marsh Crk. and Morgan Terr. Rds.), Calif., May 26, 1959 (L. M. Smith, R. O. Schuster), *ex* oak mulch; 5 ♀♀, Sierraville village quad., Calif., June 20, 1960 (F. C. Raney), *ex* soil under *Abies nobilis*.

*L. plumifer* is recognized by very bushy dorsal setae. The species is smaller than *pectinata* and has 5 setae on femora II. Groups of dorsal pits are absent or at least obscured by the emphatic dimpling.

### **Ledermuelleria pectinata (Ewing)**

(Figs. 8, 24–26)

*Raphygnathus pectinatus* Ewing, 1917 (*sic*).

*Ledermuelleria pectinatus* (Ewing), Oudemans, 1923.

*Eustigmaeus granulosus* Willmann, 1951; Summers, 1957.

*Female.* Major plates uniformly beset with closely spaced dimples; crater of each dimple completely encircled by 8–12 small, homogeneous vacuoles in skeleton (fig. 8). A polygonal reticulum appears within dimpled plating, one dimple in each cell of shadowlike reticulum. Dorsal plates also adorned with several groups of fossettes (fig. 25), these often quite difficult to locate since they do not greatly disrupt pattern of dimpling and reticulation. Humeral regions without platelike callosities; humeral plates extensive, quadrate to triangular, their ventral apices occupy pleural space between



coxal groups. Endocoxal plates of opposite sides united in mid-line to form a sternal plate between each pair of coxal groups, with or without dim, thin-lined reticulum (fig. 26). Genital plate widest at anterior third, narrowed behind to width of anogenital covers; 3 pairs genital setae thereon. Dorsal setae short, subequal on propodosoma, straight or slightly curved, axial shaft with numerous tight whorls of sharp spinules; spinules not longer than one to two times diameter of axis (fig. 24). Humeral setae *he* variable between population samples; in some specimens they conform to other dorsals; others have longer humerals of smooth, acicular type or with very few spinules. Inclusive counts of setae and sensilla on podomeres I-IV: femora 6-4-3-2, genua 4-4-1-1, tibiae 7-6-6-6, tarsi 14-10-8-7. Femur II has 1 seta less than normal; 2 proximodorsal setae *ft'*, *ft''* on tarsus I either barbed or eupathidlike. Trifid sensillum of palptarsus sessile, without extended basal shaft. Measurements in microns ( $\bar{M} \pm \sigma$ ,  $n = 10$ ): length idiosoma  $312 \pm 12$ ; width at sulcus  $225 \pm 13$ ; leg I  $151 \pm 12$ ; setae: preoculars *be*  $28 \pm 1$ ; intercalaries *li*  $39 \pm 5$ ; dorsomedians *c*  $27 \pm 4$ .

*Male.* Not described.

*New Distribution Records.* Five ♀♀, Tuolumne Meadows, Yosemite National Park, California, June 20, 1957 (D. W. Price), *ex* soil beneath pines; 2 ♀♀, Caliente (11 mi. NE), Kern County, Calif., Mar. 31, 1959 (F. C. Raney), *ex* soil and litter beneath digger pine; 1 ♀, Bridgeport (11 mi. S), Calif., May 11, 1959 (L. M. Smith), *ex* soil; 1 ♀, Centerville (5 mi. SW), Alpine Co., Calif., May 11, 1959 (L. M. Smith), *ex* pine duff; 1 ♀, Dunsmuir, Calif., July 18, 1959 (F. C. Raney), *ex* soil under poison oak; 2 ♀♀, Potter Valley (3 mi. N), Mendocino Co., Calif., July 29, 1959 (L. M. Smith, R. O. Schuster), *ex* mulch; 2 ♀♀, Little Antelope Summit, White Pine Co., Nevada, Apr. 12, 1960 (D. W. Price), *ex* soil beneath juniper; 5 ♀♀, 2 ♂♂, 2 nymphs, Callahan (12 mi. S), Siskiyou Co., Calif., July 25, 1960 (J. Campbell), *ex* soil; 3 ♀♀, Patton Mill, Tehama Co., Calif., Aug. 30, 1960 (A. A. Grigarick, R. O. Schuster), *ex* litter beneath *Umbellularia*.

The general body form, size, and plate ornamentation do not vary greatly between locality samplings, but there are several noticeable variations in the form of the setae within the range of specimens here identified as *pectinata* (Ewing). As far as material permits generalization, it appears that the more obvious differences occur between rather than within collection samples. The setae illustrated (fig. 24) represent an attempt to pictorialize the central tendency. The bushlike appearance varies somewhat; the length of the spinules may be shorter than illustrated, not exceeding the diameter of the central shaft proper, with spinules indrawn and overlapping; in other specimens the spinules are slightly longer, approximately twice the diameter of the shaft proper and project radially to minimize the overlapping of whorls.

The length of the intercalary setae *li* tends to be longer and more variable than that of the preoculars *be*. Those with shorter intercalaries also tend to have acicular humerals and eupathidlike proximodorsals on tarsi I. Locality representatives with bushlike humerals and longer intercalaries are apt to have barbed proximodorsals on tarsi I. However, correlation is imperfect since, less frequently, bushy humerals, eupathidlike tarsals, and long intercalaries occur on the same specimen.

The deutonymph of this species has a transversely divided hysterosomal plate. It closely resembles the adult female of *Ledermuelleriopsis plumosa*.

### **Ledermuelleria ottavii (Berl.) new comb.**

(Figs. 2, 22-23)

*Stigmaeus (Eustigmaeus) ottavii* Berlese, 1910.

*Eustigmaeus ottavii* Berlese, Oudemans, 1923.

*Female.* This species closely resembles *rhodomela* but with quantitative differences. Idiosoma smaller, less rotund. Plates finely punctate throughout; ornamentation of dimples on dorsal plating so faint that impressions clearly evident only in profile near downcurved margins; no reticulum apparent dorsally (fig. 2); ventral plates smooth or weakly reticulated. Line of inflection surrounding rear boundary of anogenital eminence continued forward on each side to vicinity of humeral platelets. Dorsum with several groups of fossettes as shown (fig. 23). Two convex, platelike callosities, major and minor, on each side wall above and behind humeral plate, as illustrated for *rhodomela* (fig. 32). Dorsal setae relatively long, cylindrical, gently tapered near ends to single points or ending in a cluster of several cusplike spinules; each seta with 5-8 short spinules unevenly distributed on distal two thirds of shaft (fig. 22); preoculars *be* approximately one third longer than verticals *ae*, three to four times longer than notably short humerals *he*. Chaetotaxy of leg podomeres as given for *rhodomela*. Measurements in microns ( $\bar{M} \pm \sigma$ ,  $n=8$ ): length idiosoma  $339 \pm 11$ ; width at sulcus  $251 \pm 15$ ; leg I  $205 \pm 5$ ; setae: preoculars *be*  $68 \pm 2$ , intercalaries *li*  $64 \pm 3$ , dorsomedians *c*  $63 \pm 3$ , humerals *he*  $19 \pm 2$ .

*Male.* Shows dimorphism common for genus; possesses identifying characters ascribed to female. Hysterosomal plate with a transverse groove between dorsomedian setae *b*, *c*.

*New Distribution Records.* Eight ♀♀, 2 ♂♂, Yosemite National Park (Lower Lyell Base Camp), California, June 19, 1957 (D. W. Price), *ex* pine soil.

The two species, *rhodomela* and *ottavii*, are readily separated from *clavata* since the first two possess additional pleural platelets called major and minor callosities. Differentiation between *ottavii* and *rhodomela* rests upon quantitative characters. *L. ottavii* has smaller body dimensions. The dimples in its dorsal plates, characteristic of most *Ledermuelleria* species, are so faintly impressed on the dorsum that the uppermost surface appears to be practically without sculpturing or reticulation. The humeral setae of *ottavii* are peculiarly short, and the preoculars are appreciably longer than other dorsal setae on the propodosoma.

The identification of these specimens as *ottavii* Berl. is based upon the clue that the skeletal plates have no obvious dimpling or reticulation mid-dorsally, but are uniformly stippled with very minute punctations.

### **Ledermuelleria clavata (Can. e Fanz.)**

(Figs. 1, 27-29)

*Caligonus clavatus* Canestrini e Fanzago, 1876.

*Ledermuelleria clavatus* (C. & F.), Oudemans, 1923.

[non] *Raphignathus sphagnetii* Hull, 1918; Summers, 1957. This species



referred to *Ledermuelleria* by Oudemans is apparently a species of *Stigmaeus*.

*Female*. A robust, broad-bodied species (fig. 28) with body plating thick, well sclerotized. Suranal segment of opisthosoma tucked under body so that 2 pairs suranal setae, *le* and *e*, arise in an arc behind anogenital eminence. Plates uniformly dimpled; these pits circular to oval, most  $7\ \mu$  diam. (5–12  $\mu$  range), their craters lined with thick, crinkled, detritus-covered membrane; interstices between pits wide, with an underlying shadowlike, polygonal reticulum which appears to be light-absorbing folds or trabeculae in thickened skeleton (fig. 1). Reticulated aspect of plating evident on all ventral sclerites, basis capituli, chelicerae, proximal podomeres of palpi and legs; surface otherwise without finer pattern of punctations, alveolation, or stippling. Dorsal setae stubby, clavate, slightly tapered to greatest thickness near tips, bluntly pointed; axial core differentiated from hyaline sheath, with few incipient spinules (fig. 29); preoculars *be* slightly longer than others on propodosoma. No extra plates or callosities in vicinity of humeral plate (fig. 27). Endocoxal plates between leg groups not united in mid-line, no elliptical depression between legs IV. Genital plate a discrete rounded crescent encircling anterior half of anogenital covers; its reticulation forms a fine-mesh rosette at front limit of genital aperture, with 3 pairs setae. Three pairs setae on anogenital covers. Inclusive counts of setae and sensilla on legs I–IV: femora 6-5-3-2, genua 4-4-1-1, tibiae 7-6-6-6, tarsi 14-10-8-7. Measurements in microns ( $n=3$ ): length idiosoma 430; width at sulcus 338; leg I 217; setae: preoculars *be* 58, intercalaries *li* 63, dorsomedians *c* 52.

*Male*. Not observed.

*New Distribution Record*. One ♀, Mt. Diablo, California, May 26, 1959 (L. M. Smith, R. O. Schuster), *ex* soil litter under oak, laurel, moss.

### *Ledermuelleria rhodomela* (Koch)

(Figs. 3, 30–32)

*Acarus maculatus* Schrank, 1803 (non *Acarus aquaticus maculatus* DeGeer, 1778).

*Celaeno rhodomela* Koch, 1841.

*Raphignathus patrius* Berlese, 1885.

*Raphignathus rhodomela* (Koch), Oudemans, 1897.

*Ledermuelleria patrius* (Berlese), Oudemans, 1923.

*Ledermuelleria maculatus* (Schrank), Oudemans, 1928.

*Ledermuelleria rhodomela* (Koch), Oudemans, 1928, 1937.

*Female*. A robust species similar to *clavata*. Plates minutely punctate; characteristic dimples in plating evenly spaced, but graduated in size, largest at margins, smallest middorsally (fig. 3); each dimple centers within a cell of a faintly discernible meshwork of internal trabeculae—the reticulum *sensu stricto*. Endocoxal and genital plates with sharply etched reticulum. Two convex, platelike callosities of unequal size occur on each side; large major callosity abuts uppermost rim of humeral plate; a much smaller minor callosity situated higher on pleural integument above coxae III; both callosities porous (fig. 32). Dorsal plates also provided with several groups of

coarse fossettes distributed in pattern shown (fig. 31). Dorsal setae (fig. 30) vary slightly in shape; some specimens indistinguishable from *clavata* in this respect, others have rodlike setae; preoculars *be* not noticeably longer than verticals *ae* but twice as long as humerals *he*. Three pairs genital setae; 3 pairs equally long setae on anogenital covers. Inclusive counts of setae and sensilla on legs I–IV same as given for *clavata* except each tarsus IV has an additional sensillum—a very small solenidion in proximodorsal position; spine *k* on genu I one half as long as adjacent ventrolateral seta. Measurements in microns ( $\bar{M} \pm \sigma$ ,  $n = 10$ ): length idiosoma  $423 \pm 6$ ; width at sulcus  $340 \pm 8$ ; leg I  $214 \pm 6$ ; setae: preoculars *be*  $59 \pm 3$ , intercalaries *li*  $58 \pm 2$ , dorsomedians *c*  $54 \pm 3$ .

*Male*. Not observed.

*New Distribution Records*. One ♀, Alaska, July 1952 (C. P. Alexander), specimen from collection of Miss Margaret Parsons; 1 ♀, Vineland Station, Ontario, Canada, June 14, 1955 (W. L. Putman), *ex* soil litter; 2 ♀♀, South Windsor, Connecticut, June 29, 1956 (H. Hurlbutt), *ex* soil, Pero's Orchard; 16 ♀♀, So. Windsor, Conn., May 16, 1957 (H. Hurlbutt), *ex* orchard sod; 3 ♀♀, Kern County (10.5 mi. E Cottonwood Creek Bridge), Calif., Mar. 31, 1959 (F. C. Raney), *ex* sandy loam soil.

Specimens of this mite were sent to Dr. Donald Macfarlane, British Museum of Natural History, for comparison with identified material in the museum collection. According to Macfarlane the referred mites closely resembled museum specimens labeled *patrius*. He, in turn, forwarded examples of this species to Dr. Fausta Pegazzano, Stazione di Entomologia Agraria, Firenze, Italy, for comparison with Berlese's specimens of *patrius*. Dr. Pegazzano found that the representatives submitted were not different from *Raphignathus patrius* Berlese, 1885. However, the reference specimens in the Berlese Collections (Nos. 170/19 and 216/42) are not designated as types.

Oudemans (1897, 1923) first accepted *patrius* Berl. as a distinct species but later (1928) designated both *rhodomela* K. and *patrius* Berl. as synonyms of *maculatus* Schr. In 1937, however, he rejected *maculatus* Schr. as a homonym of *aquaticus maculatus* DeG. and restored *rhodomela* as the applicable name.

The status of *Raphignathus patrius* var. *truncatus* Halbert, 1923, cannot be determined at this time.

The illustrations of *patrius* published by Berlese and Halbert show dimples of uniform size over the dorsum, whereas in the specimens studied the dimples show size gradations of smallest diameters in the dorsocentral area, largest near the margins of the back plates (fig. 3).

## Ledermuelleria lacuna Summers

(Figs. 36–39)

*Ledermuelleria lacuna* Summers, 1957.

*Female*. A robust species with considerably thickened skeletal plates. Dimples prominent on dorsum, oval or nearly round, of uniform diameter except smaller around eyes; distances between dimples about equal to their diameters; craters membranous, usually clear. Surface plating between dim-



ples with fine punctations which tend to be disposed in circular patterns around dimples; hexagonal reticulum not evident except where dorsal plates become thin near pleural margins. Dimpling of skeleton also evident on basal podomeres of palps, legs. Propodosomal plate notched on border between setae *ce*, *de*; a small anterior (major) callosity occurs on this portion of propodosomal plate (fig. 36). Hystersomal plate may or may not be similarly notched behind lateral setae *la*. Posterior (minor) callosity on hystersomal plate slightly smaller than anterior callosity, both difficult to find unless specimens rotated. Grouping of fossettes in dorsal plates approximately as shown (fig. 37). Dorsal setae stout, rodlike, with few faint spinules; tips blunt, with a tight cluster of 2–3 terminal spinules (fig. 38); preocular setae *be* just slightly longer than other dorsals; postoculars *ce* shortest, approximately one half as long as preoculars; humerals *he* approximately as long as dorsomedians *a*; other dorsals subequal. Three pairs genital setae; anogenital covers with 3 pairs setae; setae of middle pair one half the length of first and third. Counts of setae and sensilla on legs same as for *clavata*; spine *k* on genu I one half as long as adjacent ventrolateral seta. Measurements in microns ( $\bar{M} \pm \sigma$ ,  $n = 10$ ): length idiosoma  $342 \pm 15$ ; width at sulcus  $266 \pm 15$ ; leg I  $222 \pm 8$ ; dorsal setae: preoculars *be*  $61 \pm 3$ , intercalaries *li*  $54 \pm 3$ , dorsomedians *c*  $47 \pm 5$ .

*Male*. Dorsal aspect illustrated (fig. 39).

*New Distribution Records*. Fifteen ♀♀, 10 ♂♂, 8 nymphs, Post Pile Camp (8.6 mi. N), Tehama County, California, Aug. 3, 1960 (R. O. Schuster), *ex* soil with moss; 16 ♀♀, 3 nymphs, Strawberry, Tuolumne Co., Calif., Aug. 30, 1960 (D. Q. Cavagnaro), *ex* soil with moss; 5 ♀♀, same locality, Aug. 3, 1960 (D. Q. Cavagnaro), *ex* meadow soil.

The holotype (No. 2226, U.S.N.M.) is now known to be a deutonymph. Recent experience has revealed that for stigmatids in general it is always desirable, and sometimes essential, to locate the sclerotized folds, possibly valves, within the genital vestibule in order to confirm adulthood of females. Two soil samples rich in *lacuna* specimens, but containing no other stigmatids, provided ample material for recognizing adults of this species. The discrete lateral propodosomal platelets present on the deutonymph show incomplete fusion with the median plate after the final moult.

Diminutive major and minor callosities are incorporated in the margins of the dorsal plates—not floating or free in the pleural integument—and the short middle pair of setae on the anogenital covers serve to distinguish *lacuna* from *rhodomela* and from *schusteri*, next to be described.

### ***Ledermuelleria schusteri* n. sp.**

(Figs. 33–35)

*Female*. Very much like *lacuna* in respect to body size and distribution of plate dimples, punctations, fossettes. Dorsal plates without marginal incisions in shoulder region. Major callosity of substantial size, in pleural membrane close to but independent of propodosomal plate, positioned over coxae II between setae *ce*, *de*; usually discernible from above (fig. 35). No minor callosity. Dorsal setae spindle- to club-shaped, with few incipient spinules and a transparent sheath, with blunt, single-pointed tips (fig. 34);

postoculars *ce* diminutive; dorsomedians *c* slightly longer than all other dorsals (several exceptions noted); intercalaries *li* approximately as long as preoculars *be*. Fossettes on dorsal plates as illustrated, difficult to identify in many specimens. Two pairs setae on genital plate; 3 pairs on anogenital covers, subequal. Numbers of setae and sensilla on leg podomeres same as *rhodomela*; spine *k* on genu I at least three fourths as long as adjacent lateroventral setae; tarsus IV bears an extremely small solenidion. Measurements in microns ( $\bar{M} \pm \sigma$ ,  $n = 10$ ): length idiosoma  $338 \pm 19$ ; width at sulcus  $270 \pm 19$ ; leg I  $182 \pm 12$ ; dorsal setae: preoculars *be*  $58 \pm 4$ , intercalaries *li*  $60 \pm 4$ , dorsomedians *c*  $64 \pm 4$ .

*Male*. Identifiable by diminutive postocular seta *ce*, long dorsolaterals *lm* and intercalaries *li*. Dorsomedians *c* peculiarly short (fig. 33).

*Types*. Holotype ♀, Strawberry, Tuolumne County, California, Aug. 20, 1960 (D. Q. Cavagnaro), *ex* soil with moss and hepatica; allotype on same slide; deposited in the United States National Museum. Fifteen paratype females, 1 ♂, same sample, retained by authors.

*Additional Records*. Two ♀♀, Half Moon Bay (4 mi. S), San Mateo County, Calif., Sept. 25, 1960 (R. O. Schuster), *ex* moss and lichen.

The diminutive postocular setae, single pair of callosities, and 2 pairs of genital setae are recognitional characters.

### ACKNOWLEDGMENTS

Dr. D. Macfarlane was kind enough to read the first draft of this paper and to make valuable suggestions with respect to nomenclature. We are very grateful to him for his courtesies. Many thanks are also offered to Dr. Fausta Pegazzano for her obliging willingness to compare one of our species with reference specimens in the Berlese Collection.



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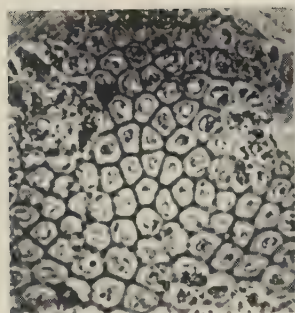
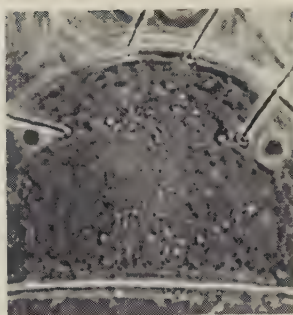
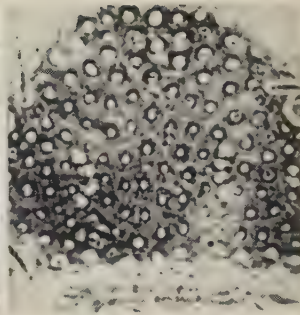
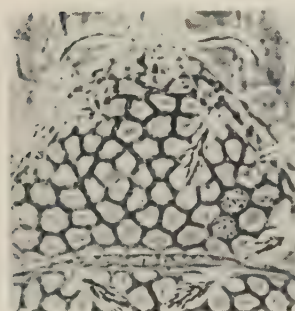
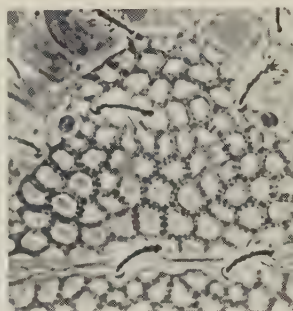
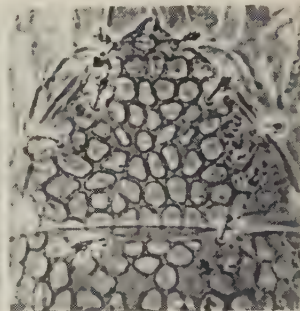
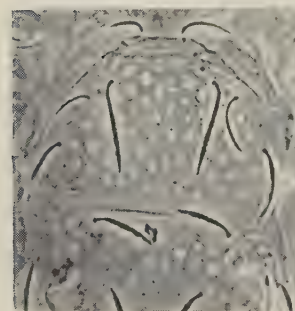
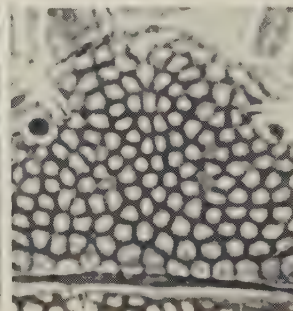
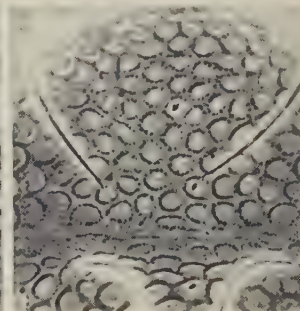
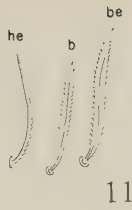
1. *clavata*2. *ottavii*3. *clathrella*4. *lirella*5. *plumifer*6. *craticula*7. *modiola*8. *pectinata*9. *segnis*

Plate 1. The minute architecture of the dorsal sclerotization is helpful in recognizing species of *Ledermuelleria*, but it is difficult to describe. Medium-phase contrast photomicrographs of the dorsal plates were made for 9 of the species. Although the mites so illustrated are not the same size, the same magnification was used throughout. The prints were cropped to show the area of the propodosomal plate between the eyes and in front of the dorsal sulcus.

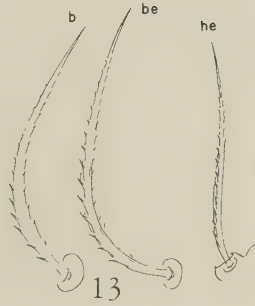




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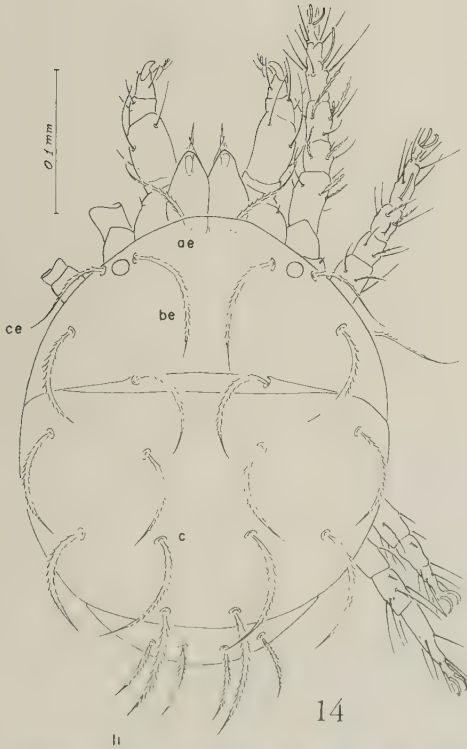
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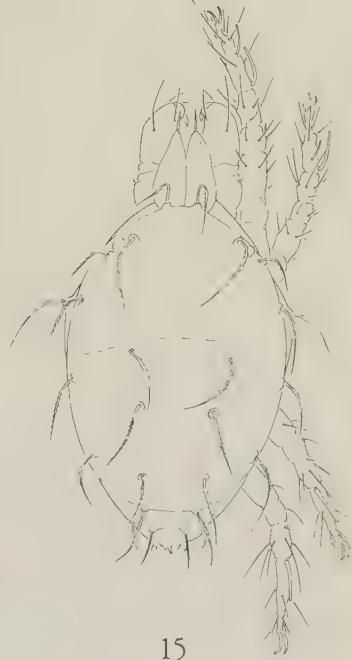
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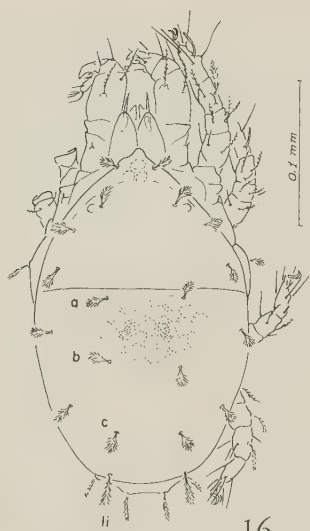


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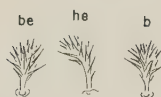


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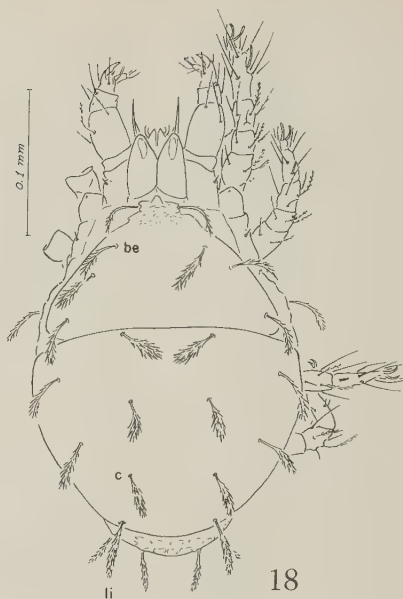
Plate 2. 10-12, *Ledermuelleria modiola*: 10, dorsal aspect of male; 11, several dorsal setae; 12, dorsal view of female. 13-15, *L. signis*: 13, representative setae; 14, dorsal view of female; 15, dorsum of male.



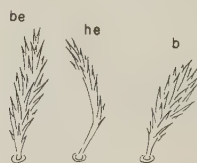
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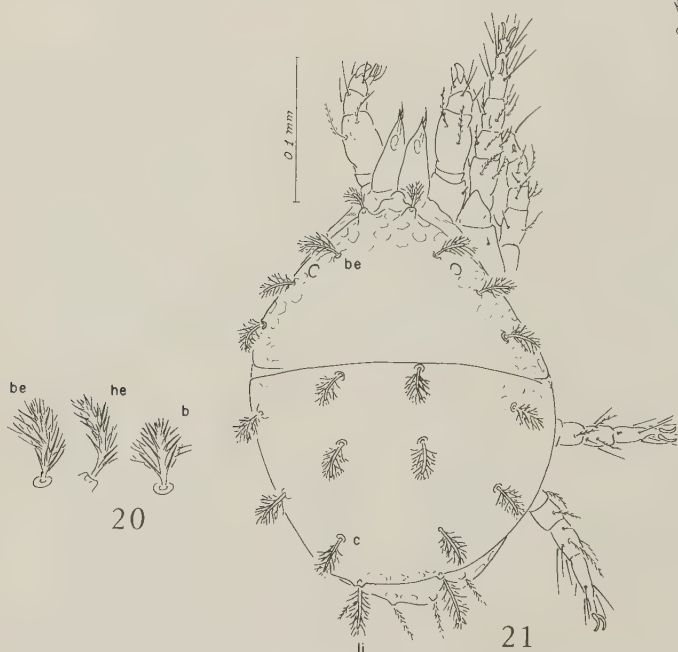
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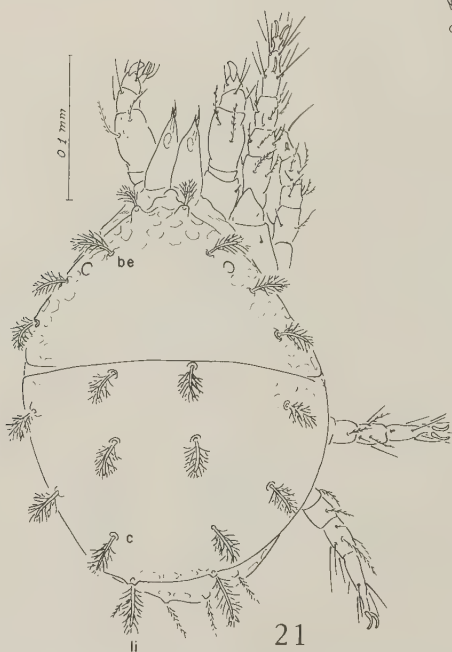
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Plate 3. 16-17, *Ledermuelleria craticula*: 16, dorsum of female; 17, dorsal setae. 18-19, *L. lirella*: 18, female, dorsal; 19, dorsal setae. 20-21, *L. plumifer*: 20, dorsal setae; 21, dorsum of female.



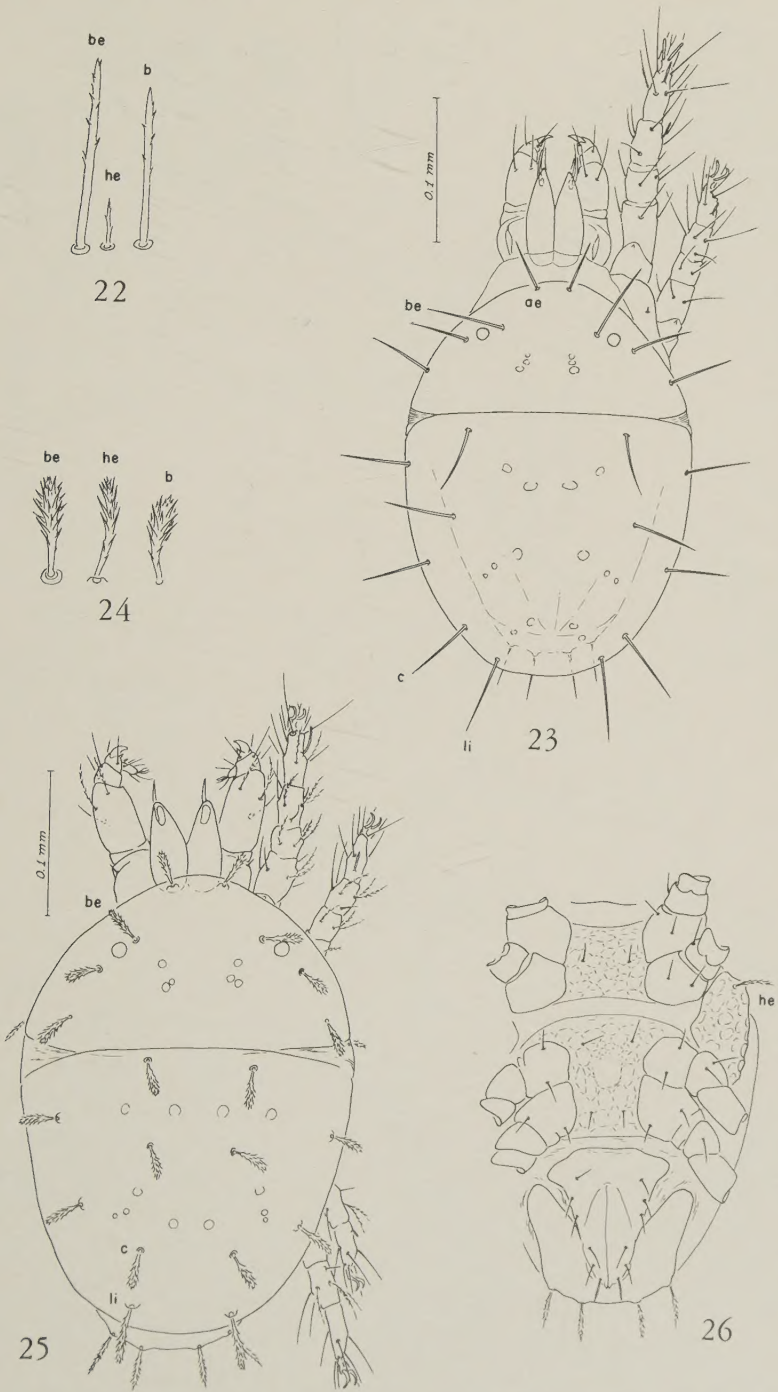


Plate 4. 22-23, *Ledermuelleria ottavii*: 22, dorsal setae; 23, dorsum of female. 24-26, *L. pectinata*: 24, dorsal setae; 25, dorsum of female; 26, ventral idiosoma, female.

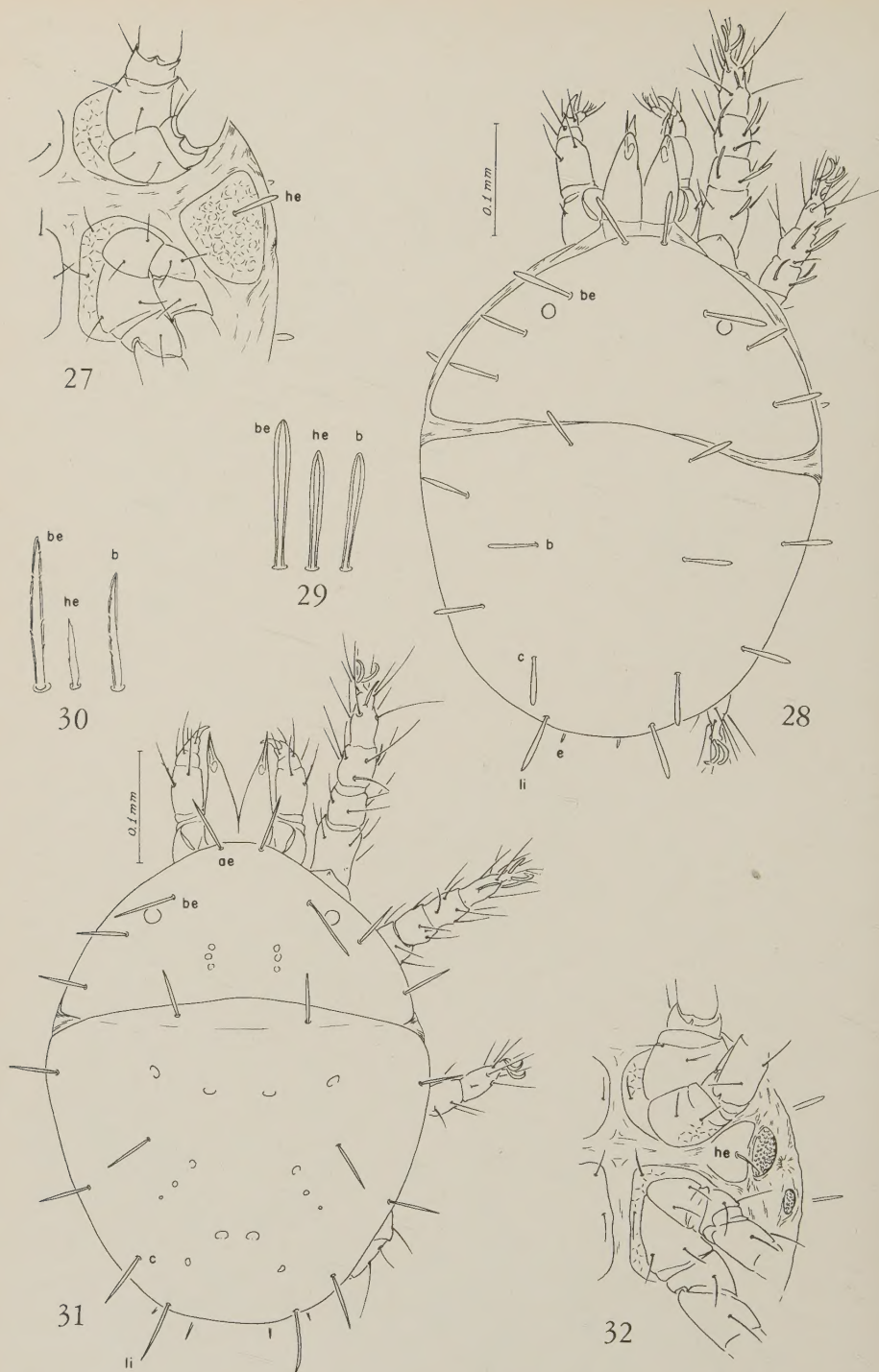


Plate 5. 27-29, *Ledermuelleria clavata*: 27, ventral podosoma of female showing ventrally displaced humeral plate, no callosities; 28, dorsum of female; 29, representative setae. 30-32, *L. rhodomela*: 30, dorsal setae; 31, dorsum of female; 32, ventral podosoma to show major and minor callosities of left side.



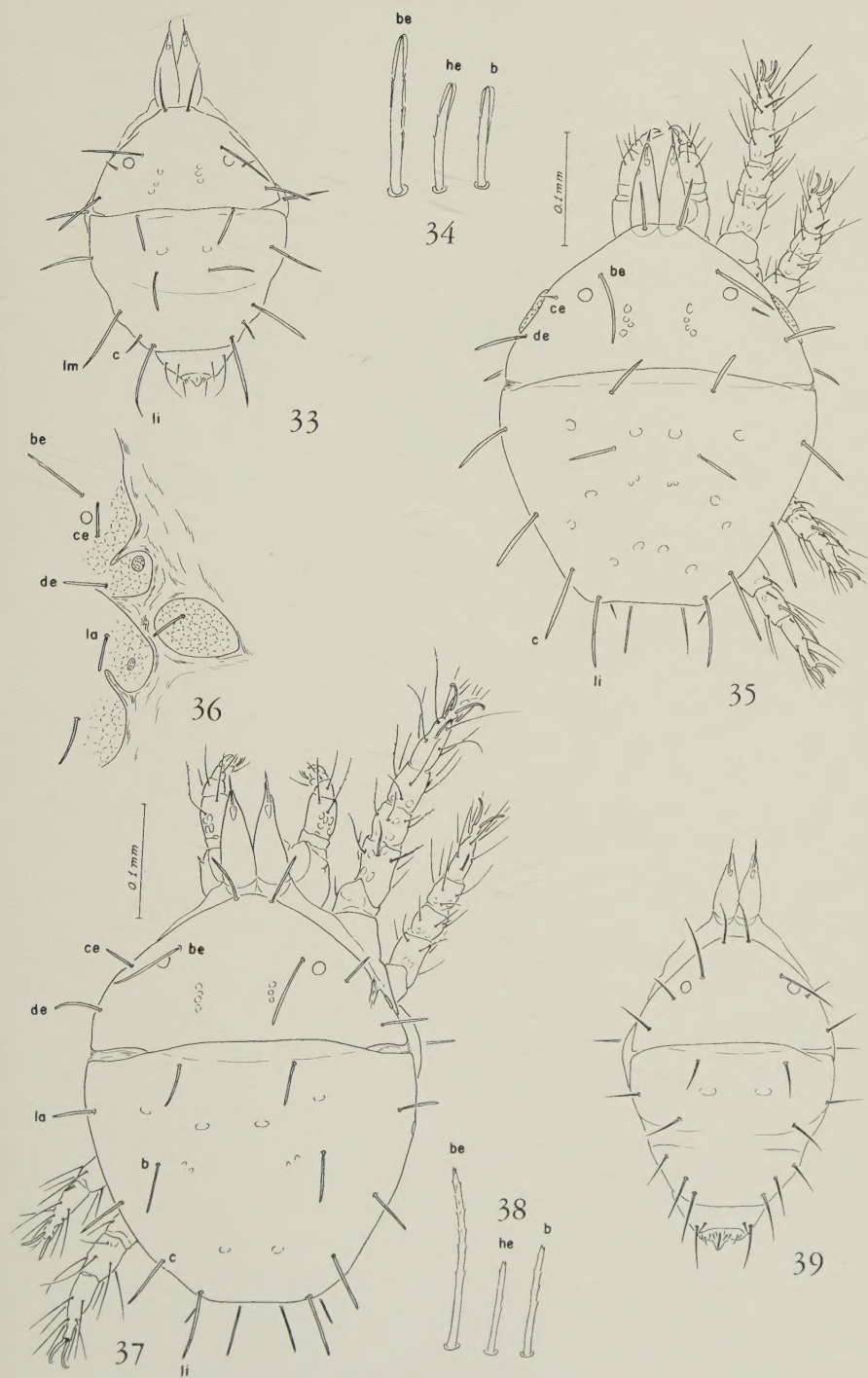


Plate 6. 33-35, *Ledermuelleria schusteri*: 33, dorsum of male; 34, dorsal setae; 35, dorsum of female. 36-39, *L. lacuna*: 36, right margin of dorsal plates, lateral view, to show notches in major plates and callosities on plates, humeral plate at right; 37, dorsum of female; 38, dorsal setae; 39, dorsum of male.

